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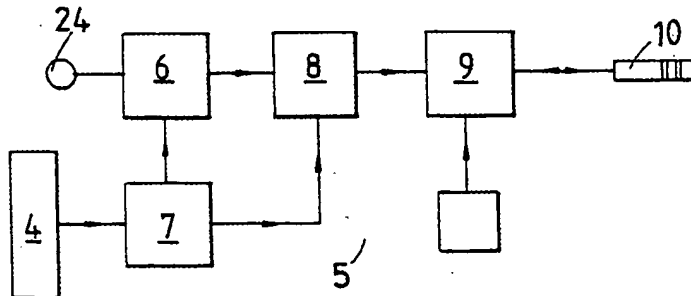
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<p>(21) International Application Number: PCT/SE90/00125 (22) International Filing Date: 22 February 1990 (22.02.90) (30) Priority data: 8900614-2 22 February 1989 (22.02.89) SE (71) Applicant (for all designated States except US): ARCUS VITA AB [SE/SE]; Hermansvägen 13, S-512 00 Svenljunga (SE). (72) Inventor; and (75) Inventor/Applicant (for US only) : RUDEKE, Jan [SE/SE]; Hermansvägen 13, S-512 00 Svenljunga (SE). (74) Agent: ÖRTENBLAD, Bertil; Noréns Patentbyrå AB, Box 27034, S-102 51 Stockholm (SE).</p>		<p>(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FI, FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), NO, SE (European patent), US. Published With international search report.</p>

(54) Title: A BED ALARM



(57) Abstract

A bed alarm intended particularly for use with patients in hospitals and like establishments for indicating when a patient leaves his or her bed, said alarm being intended for connection to an alarm terminal point in respective bed places. The invention is characterized in that the alarm includes a pressure sensor (4) which functions to detect whether a patient is lying in bed or not and which is intended to be positioned in the bed and preferably between the bed-bottom and the mattress, and further includes an alarm activating circuit (5) incorporating an alarm inhibiting circuit (6), a delay circuit (7), an impulse unit (8) and an alarm output circuit (9). The alarm inhibiting circuit (6) functions to send a first signal to the impulse unit (8) only subsequent to the lapse of a predetermined starting period, and the delay circuit (7) functions to send a second signal to the impulse unit (8) when no load has been exerted on the pressure sensor (4) for a given predetermined time period. The impulse unit (8) functions to send an impulse to the alarm output circuit (9) when the impulse unit (8) receives both the first and the second signals; and in that the alarm output circuit therewith functions to produce an alarm signal through the alarm terminal (3).

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A BED ALARM

The present invention relates to a bed alarm intended for patients under care.

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About 5% of all people above the age of 65 years suffer from some form of dementia illness. The two most common types of dementia, Morbus Alzheimer and Multi-Infarct dementia, have been the subject of intensive international research, particularly during the last
10 decennium. The state of confusion, with disorientation in time and space, combined with the psycho-motoric fear suffered by such patients renders it very difficult to attend to these patients in the home, among other things because the patient is liable to leave his/her protective environment as a result of his/her abnormal mental condi-
15 tion.

This has resulted in patients of this category being cared for in appropriate institutions. Despite regular training, such patients can never find their way around. One difficult problem is that confused
20 patients will use each other's beds, meddle with each other's personal effects in drawers and wardrobes, and are unable to find the toilet. This latter problem is particularly serious at night. The same problems and difficulties apply to patients who are predisposed to falling down.

25 The personnel responsible for care during the night period are not always available in sufficient numbers. This problem is not so acute during the day, since it is part of the general daily routine for personnel to accompany a patient to the toilet, at regular intervals. Another problem manifest during the night time and due to the small
30 staff available is the risk of patients absconding from their rooms, meaning that it is more or less necessary to lock the doors of part of such institutions.

In hospitals and other nursing institutions, an alarm terminal or
35 outlet point is normally provided at each bed place. Connected to the alarm terminal is an electric cable which is fitted with an

alarm switch on its free end. When a patient presses the switch, two poles of the alarm terminal are short circuited, resulting in the indication of an alarm in, for instance, the nurse's office or like room where attendant personnel are to be found.

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Normally patients of the aforesaid category do not have sufficient awareness to utilize this possibility of giving an alarm when requiring assistance.

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It will be evident from the foregoing that one major problem in respect of the attendant personnel is that of knowing when a patient leaves his/her bed, irrespective of the reason why.

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This problem is resolved by means of the present invention, which provides a simple and reliable bed alarm.

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The present invention thus relates to a bed alarm which is particularly intended for use with hospital patients or patients who are cared for in other institutions and for the purpose of indicating when a patient leaves his/her bed, said alarm being intended for connection to an alarm terminal point provided adjacent a respective bed place, and is characterized in that the bed alarm includes a pressure sensor which is operative to detect whether or not the bed concerned is occupied, said sensor being intended to be positioned in the bed, and preferably between the bed-bottom and the mattress, and also an alarm activating circuit which includes an alarm inhibiting circuit a delay circuit, an impulse unit, and an alarm output circuit, of which circuits the alarm inhibiting circuit functions to send a first signal to the impulse unit subsequent to expiration of a predetermined start period, and the delay circuit functions to send a second signal to the impulse circuit when no load has acted on the pressure sensor for a given predetermined time period; in that the impulse unit functions to send an impulse to the alarm output circuit when the impulse unit receives both said first and said second signals; and in that the alarm output circuit therewith functions to send an alarm signal via said alarm terminal.

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The invention will now be described in more detail with reference to

exemplifying embodiments thereof illustrated in the accompanying drawings, in which

- Figure 1 illustrates a bed without a mattress and with a sensor positioned on the bed bottom;
 - 5 - Figure 2 is a block schematic illustrating the construction of the inventive alarm system;
 - Figure 3 is a cross-sectional view of the sensor; and
 - Figure 4 is a view taken on the line A-A in Figure 3.
- 10 Figure 1 illustrates schematically a bed alarm 1 constructed in accordance with the invention. The bed alarm is intended particularly for use with patients being cared for in hospitals and like in-
- 15 institutions, so as to be made aware of when a patient leaves his/her bed 2, said alarm being intended for connection to an alarm terminal or outlet 3 provided in respective bed places.

According to the invention, the bed alarm includes a pressure sensor 4 which is operative to detect whether the bed is occupied or not. The sensor 4 is intended to be placed in the bed, preferably between

20 the bed-bottom and the mattress. The bed alarm also includes an alarm activating circuit, generally referenced 5 in Figures 1 and 2. The alarm activating circuit 5 includes an alarm inhibiting circuit 6, a delay circuit 7, an impulse unit 8, and an alarm output circuit 9. The alarm inhibiting circuit 6 is operative to send a signal to the

25 impulse unit when a predetermined starting period has lapsed. The delay circuit 7 is operative to send a second signal to the impulse circuit 8 when no load has been exerted on the pressure sensor 4 for a given predetermined time period. The impulse unit 8 is operative to send an impulse to the alarm output circuit 9, on that occurrence

30 when the impulse unit 8 receives both the first and the second signal. The alarm output circuit 9 thus functions to send an alarm signal, through said alarm terminal 3, which in Figure 2 has the form of a male plug 10 intended for insertion into a female socket of the alarm terminal 3.

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The alarm inhibiting circuit is constructed to produce said first signal after the lapse of about 15 seconds to 100 seconds, preferably after about 30 seconds. The delay circuit is constructed to produce

said second signal after a lapse of about 5 seconds to 25 seconds, preferably after about 10 seconds. As explained hereinafter, this enables a patient to be put to bed without causing repeated initiation of an alarm, and will obviate an alarm being given when a patient
5 changes his/her sleeping position, or temporarily sits up in bed, or stretches or performs some other body movement.

The aforesaid pressure sensor 4, which is illustrated schematically in cross-section in Figure 3, with the various components being
10 spaced from one another for illustrative reasons, includes two elongated thin and plate-like electric conductors 11,12 which are spaced apart with the aid of spacers 13 located at remote positions along the lengths of said conductors. Figure 4 is a view from above of the pressure sensor shown in Figure 3, said view being taken on the line
15 A-A in said Figure. Figure 4 illustrates the rectangular spaces 14-18 located in those regions where no spacer 13 is present between the two electrical conductors 11,12. These spaces are connected mutually together and also to atmosphere, via air passages 19-21. The pressure sensor is so constructed that when a patient lies in his/her bed, the
20 electrical conductors will be in contact with one another at a location between at least two adjacent spacers 13. When the force exerted on the pressure sensor is changed as a result of movement of the patient, one or more other spacers 14-18 will be pressed together, wherewith the conductors at said first mentioned spaces will move away from
25 one another, so as to break the contact between the conductors in this space.

According to one preferred embodiment, the pressure sensor has a width corresponding to the width of a bed. The bottom surface of the
30 pressure sensor is provided with a magnetic foil 22 which is intended to coact with magnetic material placed on the bed bottom. A carrier layer 23, suitably made of rigid and electrically insulating material, is positioned between the magnetic foil 22 and the bottom conductor of the conductors 12.

35

The block schematic illustrated in Figure 2 is a functional diagram. The alarm activating circuit 7 is intended to send a signal to the inhibiting circuit 6 when load is exerted on the pressure sensor 4,

whereby charging of a capacitor in the inhibiting circuit 6 commences. The charging time corresponds to the aforesaid starting time, i.e. a period of about 30 seconds. When the charging time expires, the inhibiting circuit sends a first signal to the impulse unit 8, this signal having the form of a logic "0". During the charging time, the delay circuit 7 sends a signal to the impulse unit 8 in the form of a logic "1". Thus, at this stage the impulse unit 8 receives a logic "0" and a logic "1". The impulse unit 8 includes a gate which functions to send an output signal to the alarm output signal 9 when both the first signal and the second signal are logic "0"s.

The inhibiting circuit functions to supply current to a photo diode 24 over that time period in which the capacitor is not charged. The photo diode may be connected to the output of the inhibiting circuit. When the output of the inhibiting circuit switches from a logic "1" to a logic "0", the photo diode is extinguished, indicating that the bed alarm has been activated.

The delay circuit 7 functions to produce a signal in the form of a logic "1" when load is applied to the pressure sensor, and functions to produce a logic "0", when the pressure sensor is no longer under load. However, the delay circuit includes a capacitor which causes the output of the delay circuit to the impulse unit 8 to switch from "1" to "0" after a given passage of time, as before mentioned, for instance, after 10 seconds. Thus, when the load on a previously loaded pressure sensor 4 is removed for a period longer than 10 seconds, the delay circuit will send said second signal to the impulse unit. The impulse unit will then have a logic "0" on both its inputs, and as a result will send a signal to the alarm output circuit 9. The alarm output circuit 9 will preferably include a transistor which is made conductive by said signal and which will therewith activate an alarm indicator of some suitable kind. When the bed alarm is intended for use with a fixed or stationary alarm terminal comprising two conductors between which an electric voltage prevails and which are short circuited in the case of an alarm, the transistor is arranged to short circuit these two conductors. This will thus result in an alarm being indicated through the stationary alarm installation, in the same manner as though the patient had used the initially discussed

alarm switch.

After a short lapse of time, e.g. 0.5 seconds, from the time at which the delay circuit 7 sent the second signal to the impulse unit, and thus initiated an alarm, the delay circuit functions to send a further signal, a third signal, to the inhibiting circuit 6. In this case, the inhibiting circuit is constructed so that the capacitor will first be discharged and then recharged. When the capacitor has discharged, the inhibiting circuit functions to send a signal in the form of a logic "1" to the impulse unit. This will thus stop the alarm circuit from producing an alarm, while the alarm circuit is automatically set to zero at the same time. When the capacitor has recharged and the pressure sensor is again subjected to load, an alarm will be given if the load is relieved during the time period set by the delay circuit, exemplified in the foregoing as 10 seconds.

The described circuits may have any construction suitable for realizing the aforesaid functions. The delay circuit and the inhibiting circuit will preferably include a so-called hex-Schmitt-trigger inverter-circuit, i.e. a Schmitt trigger and inverter. Alternatively, all of the capacitors included in these circuits may be replaced with an oscillator circuit and a counter, the functions of which can be programmed in a microprocessor. It will be obvious that the present circuits may be constructed in several different ways obvious to one skilled in this art.

According to one particularly preferred embodiment, current is supplied to the alarm system through the voltage prevailing in the alarm terminal, when the alarm system is connected to a fixed alarm installation. As before mentioned, when an alarm is initiated, the conductors in the alarm terminal 3 are short circuited, causing the current supply to be temporarily interrupted. As before mentioned, the alarm is broken, however, after a lapse of about 0.5 seconds, and consequently the interruption in current supply is very brief. A battery or capacitor can be provided to ensure that the circuits are not without current during this period.

According to another preferred embodiment, for those instances when the bed alarm is intended for use with a fixed alarm-terminal installation of the aforesaid kind, the alarm circuit includes an output for an alarm switch intended to be operated manually by the patient, this output being connected in parallel with the output of the alarm output circuit.

Thus, the function of the bed alarm is such as to allow about 30 seconds for the patient to be put to bed from the time of connecting the alarm to the alarm output 3. If a longer period is desired, the inhibiting circuit can be provided with another capacitor, or the bed alarm can be connected to the alarm output after the patient has been preliminarily put to bed. Subsequent to connecting the bed alarm, the patient cannot be absent from his/her bed for a period longer than about 10 seconds before the alarm is initiated. A period of 10 seconds, however, is quite sufficient to avoid a false alarm being given because the patient sits up in bed, stretches or makes some other temporary movement.

Because the alarm is automatically reset subsequent to having been initiated, as described in the foregoing, the alarm is very easy to handle.

Another very important advantage is that the alarm can be connected directly to existing, fixed or stationary alarm systems without requiring the systems to be modified. Neither is it necessary to provide a separate current supply system, since current can be supplied to the bed alarm through the alarm terminal.

However, the bed alarm can, of course, be arranged so as to enable equipment which corresponds functionally to a fixed alarm system of the aforesaid kind to be used together with the present bed alarm. In this respect, said equipment can be constructed to coact with one or more bed alarms within large establishments or within the separate apartments of an apartment building.

The present bed alarm is thus not restricted to any specific field of use.

As before mentioned, the construction of the inventive bed alarm can be modified in various ways.

- 5 Consequently, the present invention shall not be considered to be limited to the aforescribed exemplifying embodiments, since modifications can be made within the scope of the following claims.

Claims

1. A bed alarm intended particularly for use with patients in hospitals
5 and like establishments for indicating whether the bed of a patient
is occupied or not, said alarm being intended for connection to an
alarm terminal in respective bed places, c h a r a c-
t e r i z e d in that the alarm includes a pressure sensor (4) which
functions to detect whether a patient is lying in bed or not and
10 which is intended to be positioned in the bed and preferably between
the bed-bottom and the mattress, and further includes an alarm activ-
ating circuit (5) incorporating an alarm inhibiting circuit (6), a
delay circuit (7), an impulse unit (8) and an alarm output circuit
(9), of which circuits the alarm inhibiting circuit (6) functions to
15 send a first signal to the impulse unit (8) only subsequent to the
lapse of a predetermined starting period, and the delay circuit (7)
functions to send a second signal to the impulse unit (8) when no
load has been exerted on the pressure sensor (4) for a given predete-
rmined time period; in that the impulse unit (8) functions to send an
20 impulse to the alarm output circuit (9) when the impulse unit (8)
receives both said first and said second signals; and in that the
alarm output circuit therewith functions to produce an alarm signal
through said alarm terminal (3).
- 25 2. An alarm according to Claim 1, c h a r a c t e r i z e d in that
the alarm inhibiting circuit (6) functions to produce said first
signal after a time lapse of about 15 seconds to 100 seconds, prefer-
ably after about 30 seconds.
- 30 3. An alarm according to Claim 1 or 2, c h a r a c-
t e r i z e d in that the delay circuit (7) functions to produce said
second signal after a time lapse of about 5 seconds to 25 seconds,
preferably after about 10 seconds.
- 35 4. An alarm according to Claim 1, 2 or 3, c h a r a c-
t e r i z e d in that the pressure sensor (4) comprises two elongated
thin and plate-like electrical conductors (11,12) which are spaced
from one another solely at intermittent locations by means of a

spacer (13), said pressure sensor being so constructed that when the bed is occupied the electrical conductors (11,12) will be brought into contact with one another at locations between at least two mutually adjacent spacers (13).

5

5. An alarm according to Claim 1, 2, 3, or 4, c h a r a c-
t e r i z e d in that the pressure sensor (4) has a width cor-
responding to the width of a bed; and in that the bottom surface of
the pressure sensor is provided with a magnetic foil (22) intended
10 for coaction with magnetic material positioned on the bed-bottom.

6. An alarm according to Claim 1,2,3,4 or 5 for those insstances in
which the bed alarm is intended for use with a stationarily installed
alarm terminal (3) comprising two conductors between which an electric
15 voltage prevails, said conductors being short circuited by the occur-
rence of an alarm, c h a r a c t e r i z e d in that the alarm acti-
vating circuit (5) is intended to be supplied with current via the
alarm terminal (3); and in that the alarm output circuit (9) includes
a transistor or the like which functions to short circuit the two
20 conductors of the alarm output when the alarm output circuit receives
said signal from the impulse unit.

7. An alarm according to Claim 1,2,3,4,5 or 6, c h a r a c-
t e r i z e d in that the delay circuit (7) is intended, subsequent
25 to having sent said second signal to the impulse unit (8), to send a
third signal to the alarm inhibiting circuit (6), wherewith the alarm
inhibiting circuit is sest to zero; and subsequent to the expiration
of said starting period, to again send said first signal to the
impulse unit (8), therewith automatically resetting the alarm.

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8. An alarm according to any one of the preceding Claims,
c h a r a c t e r i z e d in that the alarm circuit includes an outlet
or terminal for an alarm switch which is intended to be operated
manually by the patient, said terminal being connected in parallel
35 with the output of the alarm output circuit (9).

Fig. 1

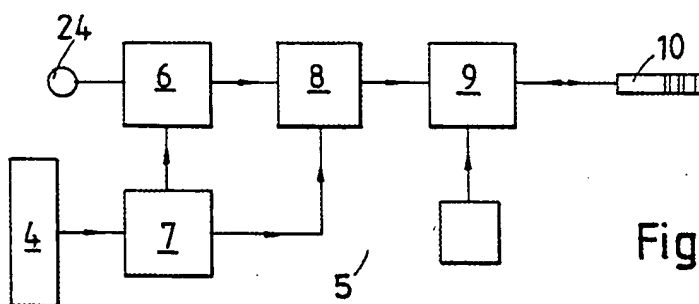
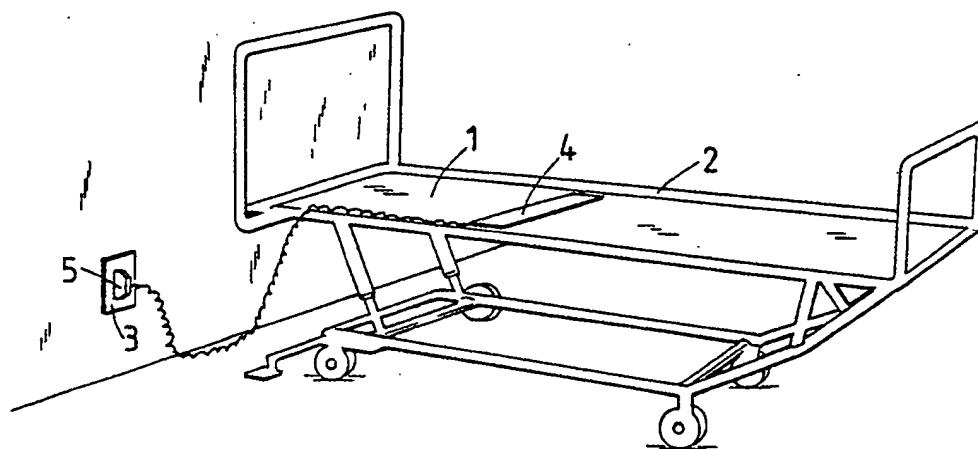


Fig. 2

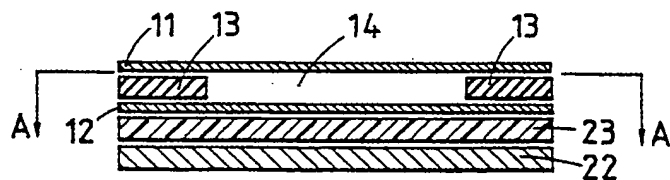


Fig. 3

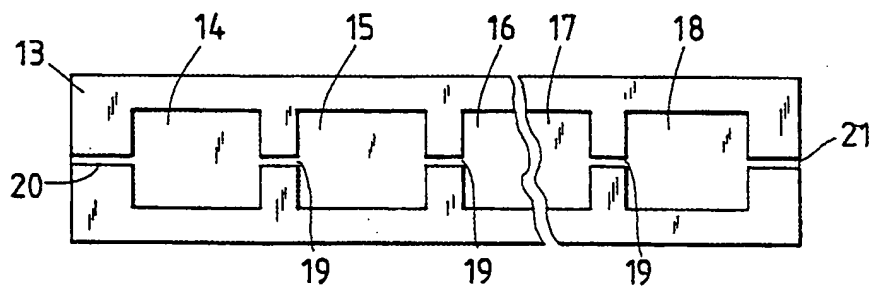


Fig. 4

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 90/00125

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC5: G 08 B 21/00, A 61 B 5/10, A 61 G 7/06		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
IPC5	A 61 B, A 61 G, G 08 B	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched ⁸		
SE,DK,FI,NO classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	EP, A, 0107058 (BED-CHECK CORPORATION) 2 May 1984, see page 16, line 16 - line 22; abstract --	1,3,4
X	DE, C, 3344612 (HILL-ROM CO. INC.) 22 January 1987, see column 5, line 11 - line 66 --	1,3,4,6,8
X	GB, A, 1484332 (K.J. COOK ET AL) 1 September 1977, see column 2, line 98 - line 114 --	1
X	US, A, 4195287 (R.G. MCCOY ET AL) 25 March 1980, see column 5, line 15 - line 61 --	1,4,6,8
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>¹⁰ * Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p> </div> </div>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
15th May 1990	1990 -05- 21	
International Searching Authority	Signature of Authorized Officer	
SWEDISH PATENT OFFICE	HARRIET EKDAHL <i>Harriet Ekdaahl</i>	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	US, A, 4228426 (W.A. ROBERTS) 14 October 1980, see column 1, line 46 - column 2, line 19 --	1-8
A	US, A, 4242672 (R.L. GAULT) 30 December 1980, see abstract -- -----	1-8

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.PCT/SE 90/00125

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on 90-05-07
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EP-A- 0107058	84-05-02	AU-B- 562562	87-06-11
		AU-B- 581356	89-02-16
		AU-D- 2124183	84-04-24
		AU-D- 6662186	87-04-09
		CA-A- 1199988	86-01-28
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		US-A- 4565910	86-01-21
		WO-A- 84/01457	84-04-12
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